April 14, 2006
Arc Flash Incident
Building 1006A
Brookhaven National Laboratory

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Accident

- April 14, 2006 at ~1020
- Building 1006A Mechanical Loft
- Engineer operates 480 V 400 amp disconnect switch
- Arc flash injuries:
  - 1st degree burns to head, face, chest, and hands
  - 1st and 2nd degree burns to forearms
- Switch panel destroyed

STAR Power Supply Overview

C-AD

The Star Detector is powered by Five independent Power Supplies:

- The Main solenoid power supply (825 V, 5300 amps)
- Two Pole tip trim power supplies (140 V, 1600 amps ea)
- Two Space trim power supplies (50 V, 600 amps ea)

Time Line

C-AD

1) Approximately 7:05 AM Friday, April 14, 2006, there was a utility power dip

2) Members of the Collider Accelerator Support Group responded to a failure of one of STAR's space trim power supplies.

3) A blown SCR fuse was replaced in one space trim power supply and five fuses were replaced in the Main Solenoid Power Supply. **No work was done on the Pole Tip Trim Power Supplies.**

4) In order to gain access to any of these power supplies all five power supplies must be locked out.

5) All five power supplies were turned on at low values and it was found that there was high current ripple on the space trim power supply which was repaired.

Time Line

C-AD

6) At approximately 9:45 am, the technician called the System Expert (SE)

7) SE determined there were additional SCR fuses blown in the space trim power supply. The supplies were locked out and the fuses replaced.

8) The supply was turned on and found to be operating normally.

9) They commenced closing the switches to allow restoration of all five power supplies.

10) Two technicians began closing the circuit breaker for the Main Solenoid power supply and SE began closing the Pole Tip Trim fuse disconnect switches.

Time Line

C-AD

12) Upon closing the West Pole Tip trim fuse disconnect switch he heard an explosion and saw sparks. This occurred approximately 10:20 am

13) SE and the two technicians left the area. Emergency services were called.

14) SE entered one of the technicians car and they drove towards the clinic. They saw an emergency service vehicle and SE was transferred to an ambulance and brought to Stony Brook University Hospital.

15) He was released from the Hospital at approximately 1:30 PM

NFPA 70-E

- PPE requirements for operating switch:
  - Non-melting or untreated natural fiber
    - Long sleeve shirt
    - Long pants
  - Safety glasses

Accident


SPACE TRIM EAST
ON
OFF
PTT WEST
3A
ON
OFF
OFF
PTT EAST
2A
ON
OFF
OFF

Injury

Injured Engineer's Cotton Short Sleeve Shirt and Cotton Undershirt

Panel Switches

C-AD

Space Trim

Space Trim

Pole Tip Tri

Pole Tip Trim East

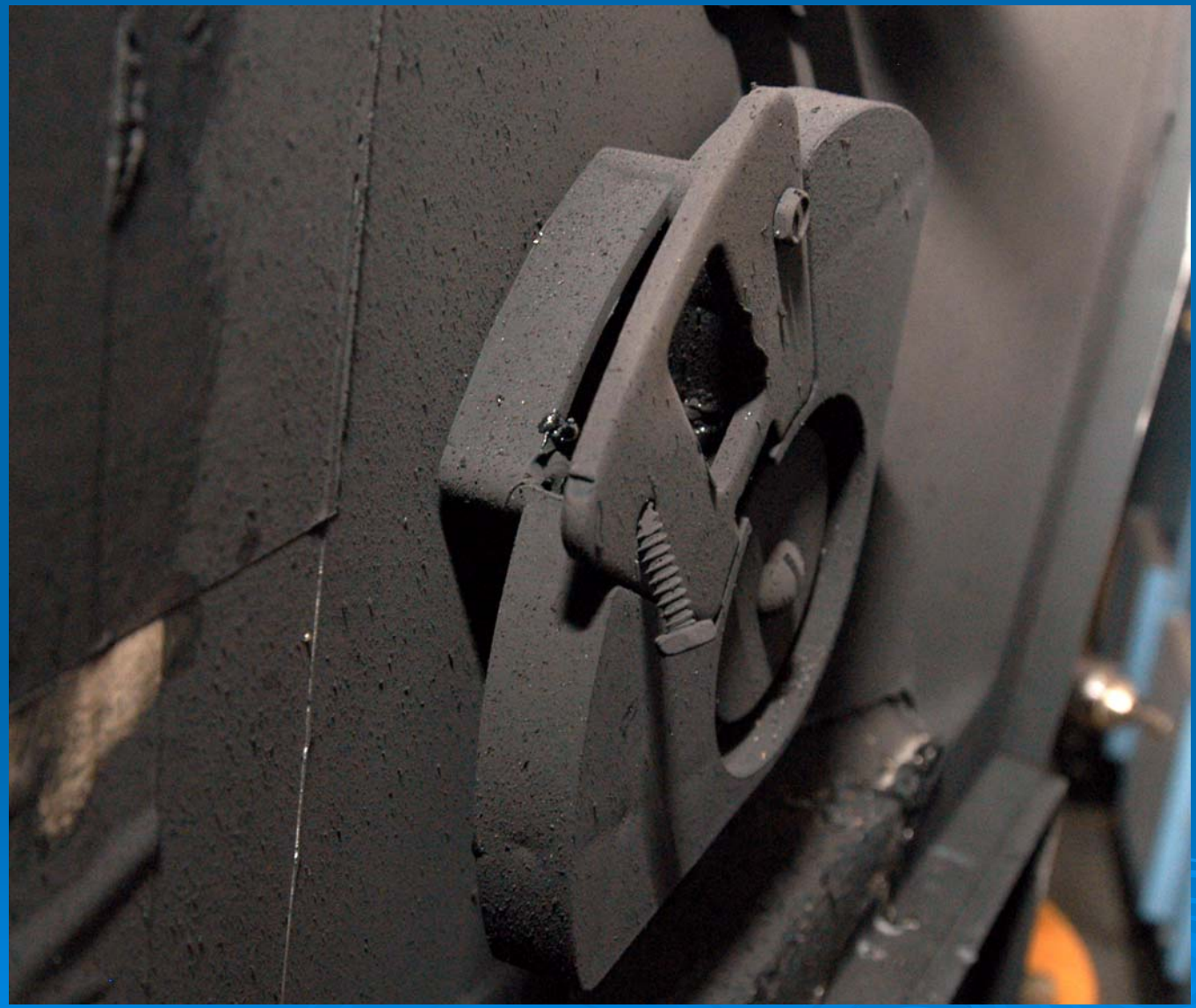
Accident

Accident

Damaged switch

Undamaged switch

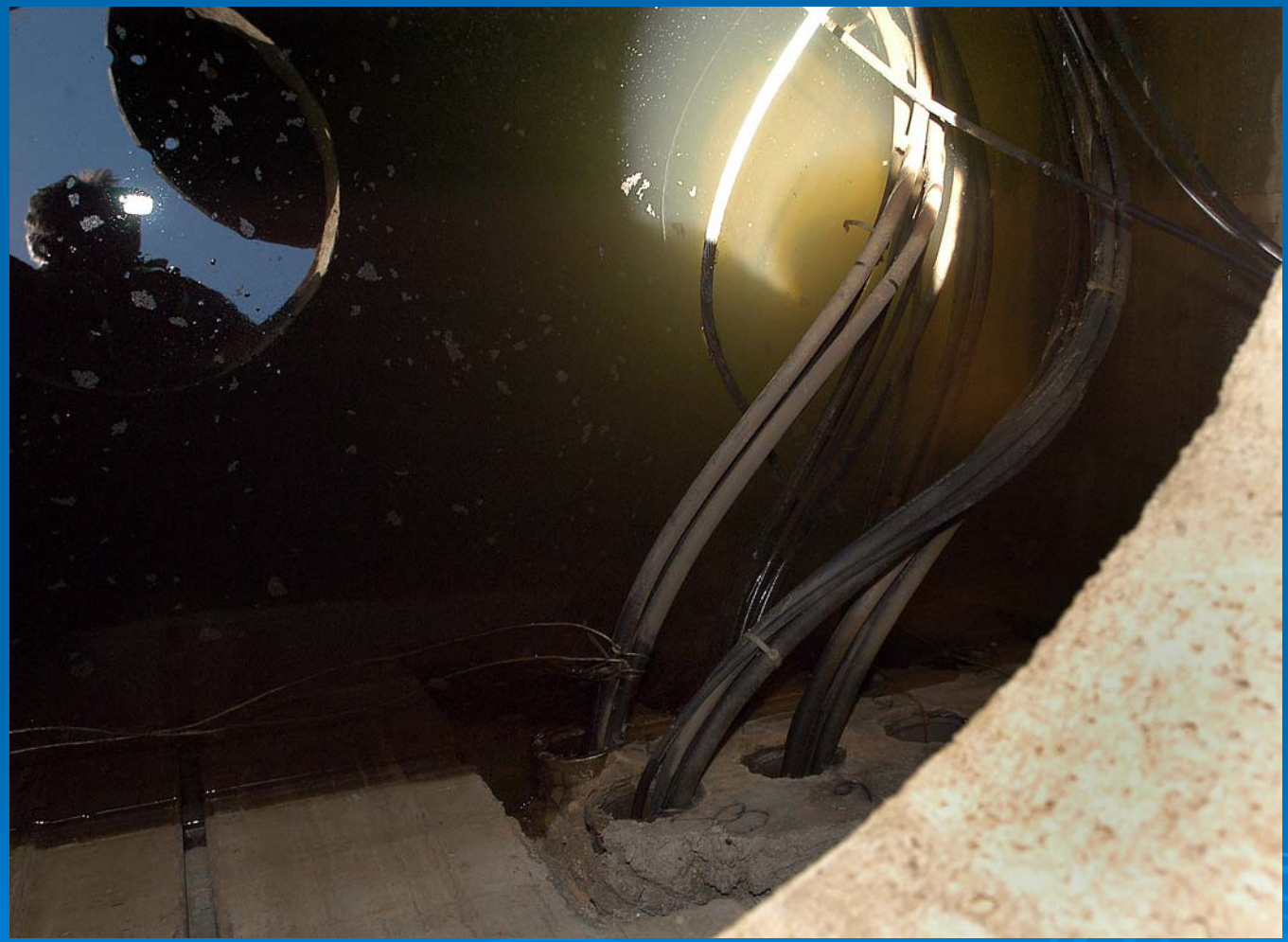
Rear view of switches




4A
OFF
ON
208 VOLTS
ON
OFF


139K (UL)


CM TYPE XHH



Possible Causes for Arc Flash

- High transient voltage
  - Arcing ground fault on ungrounded delta system (possible but unlikely)
- Foreign/loose object
  - Preliminary investigation of a similar switch indicates that the switch may have failed mechanically.
  - Area that show signs of cracking is plastic and is stressed when closing the switch.
  - If this part breaks free, it could allow a metal spring clip to enter the rear bus compartment where the arc flash occurred.

Accident Issues

- Lack of urgency for completion of energy calculations
- Divided responsibility for energy calculations
- Failure to monitor ground faults
- Lack of engineered controls to minimize voltage transients
- Maintenance requirements for switch not defined
- Inadequate understanding of NFPA 70E shock boundaries
- Inadequate one line drawings

Injury Issues

- Failure to wear PPE properly or at all
- Supervisor did not ensure engineer had PPE
- Inadequate work control

Accident Prevention Recommendations

- Activate/install ground fault detection systems
- Install systems to minimize voltage transients
- Implement a project plan for energy calculations
- Review other practices:
  - Racking circuit breakers with bus energized
  - Inserting/removing motor control center starter-buckets while energized

Injury Prevention Recommendations

- Hazard Cat 2 or greater for 480 V CB & switch operation
- Assure that PPE is worn properly